

1 CLAIMS

2 What is claimed is:

3 Claim 1. A multi-phase fuel system for use with an
4 internal combustion engine for providing a combination of
5 gaseous vaporized high volatility components of gasoline and
6 atomized liquid lower volatility components of gasoline to said
7 engine based on engine demands, comprising:

8 a fuel source which exists in a liquid state at normal
9 atmospheric pressure and temperature;

10 a fuel delivery means in fluid communication with said
11 fuel source for delivering said liquid fuel from said fuel
12 source to said multi-phase fuel system;

13 a separator means for heating said liquid fuel and
14 supplying a mixture of vaporized lower boiling temperature
15 components of said liquid fuel and atomized higher boiling
16 temperature components of said liquid fuel to said engine, said
17 separator means in fluid communication with said fuel source;

18 an on-board computer for monitoring fuel requirements as
19 a function of engine demand, said on-board computer in
20 operational control of said fuel delivery means.

21
22 Claim 2. The multi-phase fuel system as set forth in claim
23 1, wherein said multi-phase fuel system includes an air-gas
24 mixing device;

25 wherein said air-gas mixing device utilizes intake
26 manifold pressure of said engine to control the amount of said

1 vaporized low boiling components of fuel and said atomized high
2 boiling components of fuel introduced into the airstream
3 entering said engine.
4

5 Claim 3. The multi-phase fuel system as set forth in claim
6 2, wherein said air-gas mixing device includes a plunger valve;
7 wherein said plunger valve closes to substantially reduce
8 the amount of residual vaporized and atomized fuel contained
9 within said separator means from escaping therefrom.
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11 Claim 4. The multi-phase fuel system as set forth in claim
12 1, including a liquid fuel regulating means for regulating said
13 liquid fuel supplied to said multi-phase fuel system by said
14 fuel delivery means.
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16 Claim 5. The multi-phase fuel system as set forth in claim
17 4, wherein said liquid fuel regulating means includes a
18 pressure regulator for regulating the pressure of said liquid
19 fuel supplied to said fuel delivery means.
20

21 Claim 6. The multi-phase fuel system as set forth in claim
22 5, wherein said pressure regulator utilizes engine manifold
23 vacuum to regulate the pressure of said liquid fuel supplied to
24 said multi-phase fuel system by said fuel delivery means.
25

1 Claim 7. The multi-phase fuel system as set forth in claim
2 4, wherein said liquid fuel regulating means includes a liquid
3 fuel flow regulator.

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5 Claim 8. The multi-phase fuel system as set forth in claim
6 7, wherein said liquid fuel flow regulator is operatively
7 controlled by said on board computer.

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9 Claim 9. The multi-phase fuel system as set forth in claim
10 1, wherein said separator means includes:

11 a canister, said canister having an internal bore, a fresh
12 air inlet aperture and an air-fuel mixture outlet aperture;

13 at least one heating element means for supplying heat to
14 said canister bore, said heating element means being removably
15 attached to said canister;

16 at least one fuel modulating means for controlling liquid
17 fuel admitted into said canister bore, said fuel modulating
18 means constructed and arranged for removable attachment to said
19 canister, said fuel modulating means in electrical
20 communication and operatively controlled by said on-board
21 computer.

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23 Claim 10. The multi-phase fuel system as set forth in
24 claim 9, wherein said heating element means is in electrical

1 communication and operatively controlled by at least one
2 electrical switch;

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4 Claim 11. The multi-phase fuel system as set forth in
5 claim 9, wherein said heating element means is in electrical
6 communication and operatively controlled by said on board
7 computer.

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9 Claim 12. The multi-phase fuel system as set forth in
10 claim 9, wherein said heating element means for supplying heat
11 to said vaporizing chamber comprises at least one electrical
12 glow plug.

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14 Claim 13. The multi-phase fuel system as set forth in
15 claim 9, wherein said heating element means includes at least
16 one resistor, said at least one resistor constructed and
17 arranged to operatively control the temperature of said heating
18 element means.

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20 Claim 14. The multi-phase fuel system as set forth in
21 claim 9, wherein said heating element means includes at least
22 one rectifier bridge, said at least one rectifier bridge
23 constructed and arranged to operatively control the temperature
24 of said heating element means.

1 Claim 15. The multi-phase fuel system as set forth in
2 claim 9, wherein said canister bore includes at least one
3 sensor for monitoring temperature within said canister bore,
4 said sensor being removably attached to said canister, said
5 sensor being in electrical communication with said on-board
6 computer;

7 wherein said on board computer utilizes said sensor to
8 operatively control said heating elements means to regulate
9 temperature within said canister bore.
10

11 Claim 16. The multi-phase fuel system as set forth in
12 claim 9, wherein said fuel modulating means for controlling
13 liquid fuel admitted into said canister bore comprises at least
14 one fuel injector, said fuel injector in electrical
15 communication and operatively controlled with said on-board
16 computer.

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18 Claim 17. The multi-phase fuel system as set forth in
19 claim 16, wherein said fuel injector produces a superfine
20 atomized spray when said fuel injector is actuated by said on-
21 board computer.
22

23 Claim 18. The multi-phase fuel system as set forth in
24 claim 9, wherein said canister fresh air inlet includes at

1 least one air inlet control means for allowing fresh air to
2 enter said canister.

3

4 Claim 19. The multi-phase fuel system as set forth in
5 claim 18, wherein said at least one air inlet control means is
6 a check valve whereby said at least one check valve opens to
7 allow fresh air to enter said canister bore when the pressure
8 differential across said check-valve is sufficient and said
9 check valve closes said fresh air inlet aperture to prevent
10 said air/fuel mixture from flowing out of said canister when
11 said pressure differential across said check valve is
12 insufficient.

13

14 Claim 20. The multi-phase fuel system as set forth in
15 claim 19, wherein said check valve requires at least about one
16 half pound of pressure differential to open and allow said
17 fresh air to enter said canister.

18

19 Claim 21. The multi-phase fuel system as set forth in
20 claim 19, wherein said check valve includes at least one
21 aperture which is at least about one sixteenth of an inch in
22 diameter.

23

1 Claim 22. The multi-phase fuel system as set forth in
2 claim 9, wherein said canister bore includes at least one
3 insulating layer for preventing the loss of internal heat.

4
5 Claim 23. A multi-phase fuel system kit for use with an
6 internal combustion engine, said engine having a liquid fuel
7 system including a fuel source which exists in a liquid state
8 at normal atmospheric pressure and temperature and a fuel
9 delivery means in fluid communication with said fuel source for
10 delivering said liquid fuel from said fuel source to said
11 liquid fuel system, wherein said fuel system kit provides a
12 combination of vaporized high volatility components of gasoline
13 and atomized lower volatility components of gasoline to said
14 engine based on engine demands, comprising:

15 a diverter valve means for diverting said liquid fuel from
16 said liquid fuel system to said multi-phase fuel system;

17 a separator means for supplying a mixture of vaporized
18 lower temperature boiling components of fuel and atomized
19 higher temperature boiling components of gasoline to said
20 engine, said separator means in fluid communication with said
21 fuel source;

22 wherein said internal combustion engine includes an on-
23 board computer for monitoring fuel requirements as a function
24 of engine demand, said on-board computer in operational control
25 of said separator means.

1 Claim 24. The multi-phase fuel system kit as set forth in
2 claim 23 wherein said multi-phase fuel system kit includes an
3 air-gas mixing device;

4 wherein said air-gas mixing device utilizes intake
5 manifold pressure of said engine to control the amount of said
6 vaporized low boiling components of fuel and said atomized high
7 boiling components of fuel introduced into the airstream
8 entering said engine.

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10 Claim 25. The multi-phase fuel system kit as set forth in
11 claim 23 including a liquid fuel regulating means for
12 regulating said liquid fuel supplied to said multi-phase fuel
13 system by said fuel delivery means.

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15 Claim 26. The multi-phase fuel system kit as set forth in
16 claim 25, wherein said liquid fuel regulating means includes a
17 pressure regulator for regulating the pressure of said liquid
18 fuel supplied to said multi-phase fuel system.

19
20 Claim 27. The multi-phase fuel system kit as set forth in
21 claim 26, wherein said pressure regulator utilizes engine
22 manifold vacuum to regulate the pressure of said liquid fuel
23 supplied to said multi-phase fuel system by said fuel delivery
24 means.

1 Claim 28. The multi-phase fuel system kit as set forth in
2 claim 23, wherein said liquid fuel regulating means includes a
3 liquid fuel flow regulator.

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5 Claim 29. The multi-phase fuel system kit as set forth in
6 claim 28, wherein said liquid fuel flow regulator is
7 operatively controlled by said on board computer.

8
9 Claim 30 The multi-phase fuel system kit as set forth in
10 claim 23, wherein said means for supplying a mixture of
11 vaporized low boiling components of fuel and atomized high
12 boiling components of fuel comprises:

13 a canister, said canister having an internal bore, a fresh
14 air inlet aperture and an air-fuel mixture outlet aperture;

15 at least one heating element means for supplying heat to
16 said canister bore, said heating element means being removably
17 attached to said canister;

18 at least one fuel modulating means for controlling liquid
19 fuel admitted into said canister bore, said fuel modulating
20 means constructed and arranged for removable attachment to said
21 canister, said fuel modulating means in electrical
22 communication and operatively controlled by said on-board
23 computer.

1 Claim 31 The multi-phase fuel system kit as set forth in
2 claim 30, wherein said heating element means is in electrical
3 communication and operatively controlled by at least one
4 electrical switch.

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6 Claim 32. The multi-phase fuel system kit as set forth in
7 claim 31, wherein said heating element means is in electrical
8 communication and operatively controlled by said on board
9 computer.

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11 Claim 33. The multi-phase fuel system kit as set forth in
12 claim 30, wherein said heating element means for supplying heat
13 to said canister bore includes at least one electrical glow
14 plug.

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16 Claim 34. The multi-phase fuel system kit as set forth in
17 claim 30, wherein said heating element means includes at least
18 one resistor, said at least one resistor constructed and
19 arranged to operatively control the temperature of said heating
20 element means.

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22 Claim 35. The multi-phase fuel system kit as set forth in
23 claim 30, wherein said heating element means includes at least
24 one rectifier bridge, said at least one rectifier bridge

1 constructed and arranged to operatively control the temperature
2 of said heating element means.

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4 Claim 36. The multi-phase fuel system kit as set forth in
5 claim 30, wherein said canister bore includes at least one
6 sensor for monitoring temperature within said canister bore,
7 said sensor being removably attached to said canister, said
8 sensor being in electrical communication with said on-board
9 computer;

10 wherein said on board computer utilizes said sensor to
11 operatively control said heating elements means to regulate
12 temperature within said canister bore.

13
14 Claim 37. The multi-phase fuel system kit as set forth in
15 claim 30, wherein said fuel modulating means for controlling
16 liquid fuel admitted into said canister bore comprises at least
17 one fuel injector, said fuel injector in electrical
18 communication and operatively controlled with said on-board
19 computer.

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21 Claim 38. The multi-phase fuel system kit as set forth in
22 claim 37, wherein said fuel injector produces a superfine
23 atomized spray when said fuel injector is actuated by said on-
24 board computer.

1 Claim 39. The multi-phase fuel system kit as set forth in
2 claim 30, wherein said canister fresh air inlet includes at
3 least one air inlet control means for allowing fresh air to
4 enter said canister.

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6 Claim 40. The multi-phase fuel system as set forth in
7 claim 39, wherein said at least one air inlet control means is
8 a check valve whereby said at least one check valve opens to
9 allow fresh air to enter said canister bore when the pressure
10 differential across said check-valve is sufficient and said
11 check valve closes said fresh air inlet aperture to prevent
12 said air/fuel mixture from flowing out of said canister when
13 said pressure differential across said check valve is
14 insufficient.

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16 Claim 41. The multi-phase fuel system as set forth in
17 claim 40, wherein said check valve requires at least about one
18 half pound of pressure differential to open and allow said
19 fresh air to enter said canister.

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21 Claim 42. The multi-phase fuel system as set forth in
22 claim 40, wherein said check valve includes at least one
23 aperture which is at least one sixteenth of an inch in
24 diameter.

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1 Claim 43. The multi-phase fuel system as set forth in
2 claim 30, wherein said vaporizing chamber includes at least one
3 insulating layer for preventing the loss of internal heat.

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5 Claim 44. A method as practiced on an internal combustion
6 engine for supplying the components of a liquid fuel to said
7 engine in at least two different phases to enhance combustion
8 and reduce emissions comprising;

9 supplying said liquid fuel to a fuel regulating means;
10 atomizing said liquid fuel, whereby said atomized liquid
11 fuel is directed across at least one heating element means;

12 heating said atomized liquid fuel, whereby said at least
13 one heating element means is maintained at a predetermined
14 temperature for vaporizing the higher volatility components of
15 said atomized liquid fuel;

16 mixing said vaporized higher volatility fuel components
17 and said atomized lower volatility fuel components with fresh
18 air;

19 supplying said multi-phase fuel/air mixture to incoming
20 air entering said engine for combustion as required by engine
21 demands.

22
23 Claim 45. The method of claim 44 wherein said atomizing
24 step includes at least one electric fuel injector operatively
25 positioned so as to cause said liquid fuel to be injected as a

1 fine atomized mist and advance across said at least one heating
2 element.

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4 Claim 46. The method of claim 45 wherein said electric
5 fuel injector is operatively controlled to inject said liquid
6 fuel in response to engine demands sensed by an on-board
7 computer.

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9 Claim 47. The method of claim 44 wherein said heating step
10 includes at least one electric heating element operatively
11 controlled to maintain a predetermined temperature.

12
13 Claim 48. The method of claim 47 wherein said at least one
14 heating element is operatively controlled to raise the
15 temperature of said atomized liquid fuel to about 250° F.

16
17 Claim 49. The method of claim 47 wherein said at least one
18 electric heating element is a glow plug.